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## COMPLETE SPECIFICATION

METHOD FOR IMPREGNATING WOOD, AND AN APPARATUS FOR  
CARRYING OUT THE METHOD

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hereby declare the invention for which I / ~~WY~~ pray that a patent may  
be granted to me/~~WY~~, and the method by which it is to be performed,  
to be particularly described in and by the following statement:-

- 1 - (followed by page 1a)

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The present invention relates to a method for impregnating wood by means of an impregnating liquid, and an apparatus for carrying out the method.

5 Treatment of wood materials by pressure impregnation or deep impregnation has been known for some time. The object is to make the wood more resistant to rot, fungus attack and wood-boring insects. The impregnating agent is normally a liquid containing various dissolved salts, which usually have a  
10 certain toxic effect.

In the method most commonly practiced today, dry wood is placed in a pressure vessel and the tank is subjected to vacuum. The purpose of this is to draw out as much of the  
15 air in the cells of the wood as possible. Thereafter, impregnating liquid is introduced at atmospheric pressure into the impregnation tank from a special storage tank. By suction, the wood will then absorb the impregnating liquid. A drawback of this method is that the wood's ability to  
20 absorb the impregnating liquid is considerably reduced because it takes a certain amount of time before the wood is completely surrounded by the impregnating liquid. In the interim period, before the materials are completely surrounded by the liquid, the wood will absorb air and the  
25 cells of the wood will fill with air instead of the liquid. Therefore, the pressure outside and inside the cell walls will be equalized to a great degree, and the impregnating liquid achieves rather poor penetration into the wood.

30 Upon closer examination of this known process, it has been observed that in spite of the fact that the wood loses a major part of the gas volume contained in its cells, not all of the volume once occupied by this gas is replaced by the impregnating substance, even after the materials have  
35 been completely submersed in the liquid. Since no deformation of the materials occurs, either, it must be assumed that the remaining volume has been taken up by some substance other than the impregnating liquid.

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Logically, this substance must be gas. This gas consists in part of air which is absorbed by the wood as the liquid is being added, as discussed above, but in addition, it is likely that gas is also drawn out of the liquid, according 5 to the law of the solubility of gases in liquids in relation to the gas pressure above the liquid. The cell membranes in wood are of such nature that they can confine, for example, glucose molecules, while allowing water molecules to pass through. In other words, small molecules may more easily 10 pass through the membrane than large molecules. A large proportion of the molecules which pass through the membrane into the cells in the known impregnation method, therefore, will be gas molecules from the impregnating liquid, and this reduces the possibility for the liquid molecules in 15 the impregnating substance to penetrate the cells. This naturally leads to poorer penetration of the impregnating liquid in the types of wood, especially pine, which today are considered impregnable by this method. It also means that other important kinds of wood, such as fir, are now 20 considered unsuitable for pressure impregnation treatment, owing to the difference in cell structure of the two conifers. As a result, only pine wood is treated according to the above-described method in Norway, and this limitation naturally constitutes a serious drawback of 25 the method.

The object of the present invention is to improve this method of impregnating wood materials, with the aim of increasing the depth of impregnation and making it possible 30 to impregnate types of wood which heretofore have been considered unsuitable for treatment by pressure impregnation or deep impregnation.

This object is obtained through a method for impregnating 35 wood by means of an impregnating liquid, wherein the wood is placed in an airtight pressure-resistant impregnation tank from which the air has been completely or almost

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completely evacuated, and the impregnating liquid, following its introduction into the tank, is subjected to pressure, and the method is characterized in that the impregnating liquid is completely or almost completely de-aerated of its 5 gas and/or air content prior to being pressurised in the impregnation tank, and that impregnation takes place without contact with air or gas, whereby the liquid is completely or almost completely devoid of gas and air during 10 impregnation when the liquid is penetrating into the wood, and gas and/or air have no opportunity to penetrate into the wood between the evacuation of the tank and impregnation of the wood.

The basic idea of the invention is that the vacuum in the 15 wood, or more correctly in the cells of the wood, is established and maintained prior to and during the introduction of the liquid, causing the impregnating liquid to be "sucked up" through the cell walls, thus filling the cells with impregnating liquid. Therefore, there is no 20 opportunity for an equalization of pressure between the cells and the surroundings to occur prior to the penetration of the impregnating liquid through the cell walls.

In a practical embodiment of the method, de-aeration or 25 removal of the air content from the impregnating liquid takes place in a separate tank.

In a further development of the method, the pressurisation of the impregnating liquid, after it has been introduced into 30 the impregnation tank, is produced by reducing the volume in the impregnation tank, or by introducing the liquid under pressure and without contact with air or gas.

A somewhat modified embodiment of the method involves 35 introduction of the impregnating liquid into the tank prior to evacuation, whereby the wood is completely submerged in the liquid prior to evacuation of the tank, and the liquid

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and the wood material being impregnated are thereafter subjected to pressure.

In a further feature of the method, the impregnating liquid can be  
5 introduced into an elastic container disposed within the tank. The space  
between the pressure resistant tank shell and the elastic  
container is first evacuated, then the interior of the  
elastic container is evacuated to about 95% vacuum or higher,  
and pressure is thereafter introduced into the space  
10 between the pressure resistant tank shell and the elastic  
container, utilizing a pressure of about 4 bar or higher, as  
known per se.

Yet another characterizing feature of the method of the  
15 invention is that vacuum is produced in an expansion tank  
communicating via a pipe with the impregnation tank, the  
expansion tank being closed off from the tank during  
evacuation by means of a valve, and the valve is opened  
after the desired vacuum has been achieved in the expansion  
20 tank, thereby lowering the pressure in the tank.

An apparatus for carrying out the method comprises an  
impregnation tank for containing the wood that is to be  
impregnated and including the necessary equipment for  
25 producing a vacuum in the tank, and pipes connecting the  
impregnation tank to a storage tank containing the  
impregnating liquid, for supplying the liquid to the  
impregnation tank after the latter has been evacuated, and  
the most important characterizing features of the apparatus  
30 are that, in connection with the storage tank, equipment is  
provided for completely or almost completely evacuating the  
air or other gas from the tank and from the impregnating  
liquid contained therein, and in connection with the impregnation  
35 tank, equipment is provided for increasing the  
pressure in the tank under completely airtight conditions.

In a practical embodiment of the apparatus of the invention,



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the equipment for increasing the pressure in the impregnation tank consists of a means for reducing the volume in the tank, which can be achieved, for example, by arranging one or more inflatable, elastic containers in the tank or in

5 a liquid-conducting pipe provided in connection with the tank, or by providing one or more displacement pistons, or by providing a pressure pump in the pipe between the storage tank and the impregnation tank.

10 The invention will be described in more detail in the following with reference to the accompanying drawing, which shows an exemplary embodiment of an apparatus for carrying out the method of the invention.

15 The wood 1 to be impregnated is placed in an airtight, pressure resistant impregnation tank 2. One or more elastic containers 3 are disposed inside the impregnation tank 2. Prior to initiating impregnation of the wood 1, the air in the container 3 is evacuated by means of a vacuum pump 4

20 via the pipes 5, 6, 7 and 8, while valves 9,10 in the pipes are open. After the air has been evacuated, the valve 10 is closed. Thereafter, a storage tank 11 communicating with the vacuum pump 4 via pipes 12 and 13 is evacuated by opening a valve 14, which is subsequently closed when

25 evacuation has been accomplished. By means of the vacuum pump 4, the air in the impregnation tank 2 is then evacuated via the pipes 5, 12 and 15, the valves 9 and 16 being open until the desired evacuation has been obtained, and then closed. All or virtually all of the air or other

30 gas has now been evacuated from both the impregnation tank 2 and the storage tank 11, which also operates as an expansion tank, and the air or gas fraction has also been almost completely removed from the impregnating liquid 17 contained in the storage tank 11.

35 The impregnation process is initiated by opening the valves 18 and 19, which allows the impregnation tank 2 to be filled

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with impregnating liquid from the tank 11, the storage tank 11 being situated at a higher elevation than the impregnation tank 2. During the transfer of liquid, the tank 11 is subjected to suction by means of the vacuum pump, the valves 5 9 and 14 being open, until such time as the gas pressure in the liquid is equal to the gas pressure above the liquid. The valves 18 and 19 are then closed.

From a source of compressed air  $P$ , a pressure medium is 10 introduced through a valve 20 to the elastic container 3, causing this to expand until the pressure within the tank 2 rises to 16 bar or higher. After this pressure has been maintained for a sufficient length of time, depending on the volume and nature of the material being impregnated, 15 the pressure is lowered, and the impregnating liquid is evacuated from the tank 2. The container 3 is connected to the vacuum pump and emptied.

If the materials have absorbed too much liquid, vacuum can 20 again be applied to the tank 2 for drawing out the excess impregnation liquid from the wood.

When evacuating the tank 2, the pressure ought to be lowered to or almost to the boiling point of the impregnating liquid as rapidly as possible, whereupon the valves 25 18 and 19 are immediately opened for introducing the impregnating liquid to the tank.

The apparatus described and illustrated hereinabove is 30 exemplary in character, and it can be altered in a number of ways without departing from the scope of the invention as disclosed in the appurtenant patent claims. Thus, a displacement piston, for instance, could be provided instead of the elastic container for reducing the volume and thereby increasing the pressure in the impregnation tank. The 35 pipe system for pumping out the air and gas in the tanks can be made in various ways, for example using two pumps.

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The pressure increase in the impregnation tank 2 can also be achieved by providing a pump unit in the tank 11 or in a conduit between this tank and the impregnation tank, which pumps liquid from the tank 11 to the impregnation tank 2, 5 under such conditions that the liquid will not come in contact with gas or air. The pressure in the impregnation tank 2 will then rise to the desired value, while the pressure in the tank 11 will drop. Since the pressure in the tank 11, owing to the evacuation, is already at the 10 liquid's boiling point, the surface of the liquid will boil. The loss in volume of the liquid in the tank 11 causes a further reduction in pressure, but this reduction in pressure is compensated for by the pressure of the vapour from the boiling liquid.

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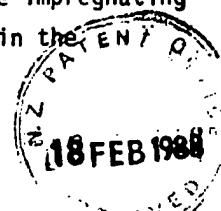


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## WHAT WE CLAIM IS:

1. A method for impregnating wood by means of an impregnating liquid, wherein the wood is placed in an airtight, pressure-resistant impregnation tank from which the air is completely or almost completely evacuated, and the impregnating liquid, following its introduction into the tank, is subjected to pressure, characterized in that the impregnating liquid is completely or almost completely de-aerated of its gas and/or air content before it is pressurised in the impregnation tank, and that impregnation occurs without contact with air or gas, whereby the liquid is completely or almost completely devoid of gas and air during impregnation when the liquid is penetrating into the wood, and gas and/or air have no opportunity to penetrate into the wood between the evacuation of the tank and impregnation of the wood.
2. A method according to claim 1, characterized in that the impregnating liquid is de-aerated by application of vacuum in a separate storage tank, and is thereafter introduced into the impregnation tank.
3. A method according to claim 1 or 2, characterized in that the pressurisation of the impregnating liquid following its introduction into the impregnation tank is produced by reducing the volume in the impregnation tank, or by introducing the liquid under pressure and without contact with gas or air.
4. A method according to claim 1, characterized in that the impregnating liquid is introduced into the tank prior to evacuation, such that the wood materials are completely submerged in the liquid prior to evacuation of the tank, and that the liquid and wood are thereafter subjected to pressure.
5. A method according to claim 4, characterized in that the impregnating liquid is introduced into an elastic container disposed within the impregnation tank.



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6. A method according to claim 5, characterized in that the space between the pressure resistant tank shell and the elastic container is first evacuated, then the interior of the elastic container is evacuated to about 95% vacuum or higher, and that pressure is thereafter introduced into the space between the pressure resistant tank shell and the elastic container at a pressure, as known per se, of about 4 bar or higher, the already de-aerated impregnating liquid being introduced into the interior of the elastic container.

7. A method according to claim 4, characterized by evacuating with a vacuum pump an expansion tank that communicates via a pipe with the impregnation tank, said expansion tank being closed off from the impregnation tank during evacuation by means of a valve, and opening the valve after the desired vacuum has been achieved in the expansion container, thereby lowering the pressure in the tank.

8. An apparatus for carrying out the method recited in any one of claims 1 to 3, comprising an impregnation tank for containing the wood to be impregnated and including the necessary equipment for producing a vacuum in the tank, and pipes connecting the tank to a storage tank containing impregnating liquid for supplying the impregnating liquid to the impregnation tank after the latter has been evacuated, characterized in that in connection with the storage tank, equipment is provided for completely or almost completely evacuating the air or other gas from the tank and from the impregnating liquid, and in connection with the impregnation tank, equipment is provided for increasing the pressure in the tank under conditions whereby the impregnating liquid is without contact with air or gas.

9. An apparatus according to claim 8, characterized in that the equipment for increasing the pressure in the impregnation tank consists of a means for reducing the volume of the impregnation tank.



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10. An apparatus according to claim 9 characterized in that the means for reducing the volume of the impregnation tank consists of one or more inflatable elastic containers arranged in the tank.

11. An apparatus according to claim 9 characterized in that the means for reducing the volume of the impregnation tank consists of an inflatable elastic container in a liquid-conducting pipe connected to the tank.

12. An apparatus according to any one of claims 8 to 11 characterized in that a common vacuum pump is provided for the storage tank and the impregnation tank.

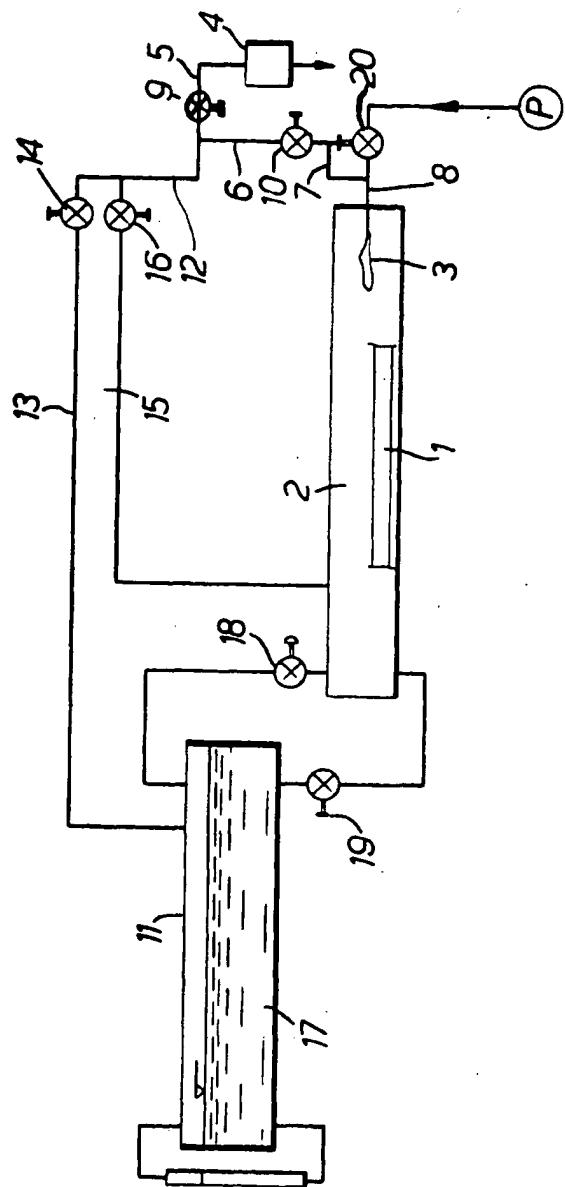
13. An apparatus according to any one of claims 8 to 12, characterized by the provision of a pressure pump for introducing the previously de-aerated impregnating liquid from the storage tank to the impregnation tank.

DATED THIS 18<sup>th</sup> DAY OF February 1988  
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AGENTS FOR THE APPLICANTS



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**END**